DOCUMENT RESUME

ED 215 650 HE 015 034

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TITLE 1980-81 Survey of Physics and Astronomy Bachelor's Degree Recipients.
INSTITUTION American Inst. of Physics, New York, N.Y. Manpower Statistics Div.
REPORT NO AIP-R-211-13
PUB DATE Mar 82
NOTE 10p.
AVAILABLE FROM American Institute of Physics, 335 East 45 Street, New York, NY 10017.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Aspiration; *Astronomy; Bachelors Degrees; *Career Planning; Degrees (Academic); Educational Background; *Employment Patterns; Foreign Students; *Graduate Study; Higher Education; Military Service; Minority Groups; Occupational Aspiration; *Physics; Salaries; *Student Characteristics; Undergraduate Students

ABSTRACT

The postbaccalaureate plans of 1980-1981 physics and astronomy graduates were surveyed and compared with previous graduates. Data are presented on annual changes in postbaccalaureate plans during 1971-1981 with respect to the following options: physics graduate study, other graduate study, civilian employment, military service, and undecided. Postbaccalaureate plans are also correlated with the following characteristics: sex, citizenship, age, minority status, double major, and type of undergraduate institution. Data are also presented on: the students' secondary school training in physics, U.S. and foreign minorities among physics bachelors, seven minority groups, sources of anticipated support for first-year graduate study (1979-1981), changes in employment outlook for new physics bachelors (1973-1981), initial employment of physics bachelors (1974-1981), starting salaries of 1981 physics bachelors, and full-time employment of 1981 physics bachelors. Additionally, plans of graduating classes of astronomy bachelors (1974-1981) and characteristics and starting salaries of 1981 astronomy bachelors are examined. Findings include the following: (1) a small shift from civilian to military employment plans was evident; (2) U.S. blacks comprise the smallest proportion of physics bachelors with plans for graduate study and the largest proportion with employment plans; (3) a decline occurred in both the number and proportion of astronomy bachelors with plans for graduate study; and (4) the percentage of physics bachelors who had not taken high school physics but planned graduate physics study quadrupled since 1970. (SW)

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ED215650

AIP Report - Manpower Statistics Division

AMERICAN INSTITUTE OF PHYSICS, 335 East 45 Street, New York, NY 10017

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1980-81

# SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECIPIENTS

by Susanne D. Ellis

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# 1980–81 SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECIPIENTS

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AIP Pub. No. R-211.13

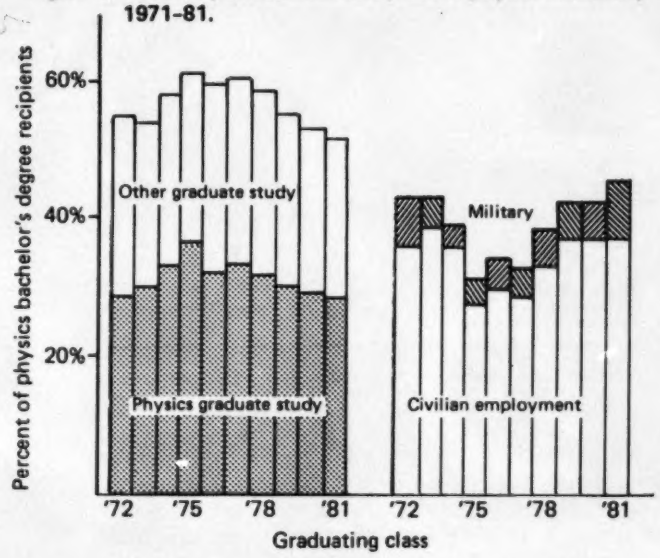
March 1982

According to the physics and astronomy degree granting departments in all 50 states, 4513 physics and 156 astronomy bachelor's degrees were granted during the academic year 1980–81. The information presented in this report comes from individual degree recipients and focuses on their postbaccalaureate plans. Highlights of this report are:

- —a small shift from civilian to military employment plans
- —the percentage of physics bachelors who had not taken high school physics and plan graduate physics study, quadrupled since 1970.
- —an expanded analysis of minority data shows that U. S. blacks comprise the smallest proportion of physics bachelors with plans for graduate study and the largest proportion with employment plans
- —a decline can be noted in both the number and proportion of astronomy bachelors with plans for graduate study

**Figure I** shows the annual changes in postbaccalaureate plans over a ten-year period during which time the size of the graduating class decreased by 15%. For the purposes of **Figure I** postbaccalaureate plans are divided into four parts so that the first set of bars presents two types of graduate study—physics and all "other" combined, while the second set of bars separates physics bachelors with military commitments from those interested in civilian employment.

**Figure I. Trend in postbaccalaureate plans of physics bachelors, 1971–81.**




The numerical data for the bars in **Figure I** are presented in **Table I** from which we can identify the most recent change as one toward the opportunities offered by the military. The one percentage point decline in "physics graduate study" appears to be offset by the report that 2% of the employment-oriented bachelors plan to return for physics graduate study in one year.

**Table I. Postbaccalaureate plans of successive graduating classes of physics bachelors, 1971–1981.**

| Postbaccalaureate plans | 1971–72 | 1972–73 | 1973–74 | 1974–75 | 1975–76 | 1976–77 | 1977–78 | 1978–79 | 1979–80 | 1980–81 |
|---|---|---|---|---|---|---|---|---|---|---|
| Physics graduate study | 30% | 31% | 34% | 36% | 32% | 34% | 33% | 31% | 30% | 29% |
| Other graduate study | 26 | 24 | 25 | 27 | 28 | 28 | 26 | 24 | 24 | 24 |
| Civilian employment | 37 | 39 | 36 | 28 | 31 | 30 | 34 | 38 | 38 | 38 |
| Military service | 7 | 5 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 7 |
| Undecided | | 1 | 1 | 5 | 5 | 4 | 2 | 2 | 3 | 2 |
| Total number of physics bachelor's degrees | 5282 | 4923 | 4652 | 4571 | 4487 | 4517 | 4457 | 4416 | 4440 | 4513 |

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AMERICAN PHYSICAL SOCIETY • OPTICAL SOCIETY OF AMERICA • ACOUSTICAL SOCIETY OF AMERICA • SOCIETY OF RHEOLOGY • AMERICAN ASSOCIATION OF PHYSICS TEACHERS • AMERICAN CRYSTALLOGRAPHIC ASSOCIATION • AMERICAN ASTRONOMICAL SOCIETY • AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE • AMERICAN VACUUM SOCIETY

**Table II. Characteristics of new physics bachelors, 1980-1981.**

| Characteristics | Postbaccalaureate plans: Graduate study: physics | Graduate study: other | Employment | Undecided | Total |
|---|---|---|---|---|---|
| **Sex** | | | | | |
| Female* | 8% | 11% | 13% | 17% | 11.2% |
| Male | 92 | 89 | 87 | 83 | 88.8 |
| **Citizenship** | | | | | |
| U.S. | 92% | 91% | 98% | 95% | 94.7% |
| Foreign | 8 | 9 | 2 | 5 | 5.3 |
| **Age** | | | | | |
| 20 or younger | 1% | 1% | - | 2% | 0.7% |
| 21 | 7 | 7 | 4% | 9 | 5.8 |
| 22 | 51 | 52 | 42 | 50 | 47.3 |
| 23 | 20 | 23 | 23 | 19 | 21.8 |
| 24-29 | 18 | 15 | 26 | 18 | 20.6 |
| 30 and older | 3 | 2 | 5 | 2 | 3.8 |
| **Minority groups** | | | | | |
| U.S. blacks | 1.4% | 1.1% | 2.1% | - | 1.6% |
| Other U.S. minorities | 4.3 | 3.5 | 3.4 | - | 3.6 |
| Foreign minorities | 5.2 | 6.9 | 1.1 | - | 3.7 |
| **Double major** | | | | | |
| Yes | 25% | 40% | 28% | 25% | 30% |
| No | 75 | 60 | 72 | 75 | 70 |
| **Type of undergraduate institution** | | | | | |
| PhD-granting | 58% | 42% | 42% | 43% | 47.0% |
| MS-granting | 15 | 9 | 14 | 14 | 13.1 |
| BS/BA-granting | 27 | 49 | 44 | 43 | 39.9 |
| Total number of bachelors | 1327 | 1079 | 2008 | 99 | 4513 |
| % distribution | 29% | 24% | 45% | 2% | 100% |
| Number of respondents | 766 | 621 | 1160 | 57 | 2604 |

**Percentage of women was adjusted for differential response rate.*

**Table II** divides the physics bachelors into three major groups and one small group of "undecided" graduates; as shown, their characteristics differ significantly. For example the proportion of women is much greater for the group interested in immediate employment than for the group which enters a graduate physics department for a higher physics degree.

Foreign physics bachelors are almost exclusively among the graduates who plan graduate study without interruption.

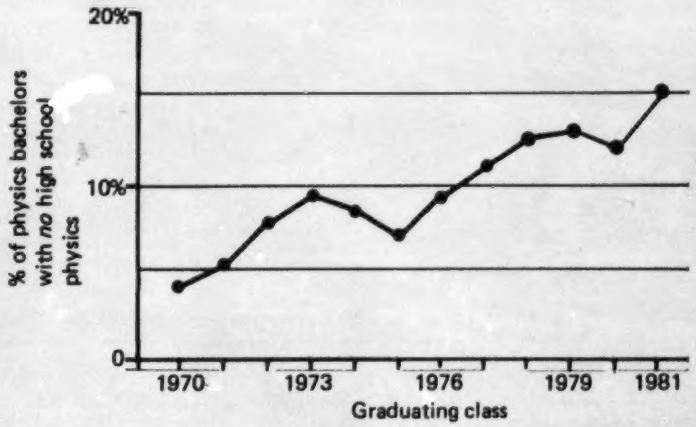
As in previous years the youngest group among the physics bachelors is the one interested in "other graduate study". On the other hand, graduates who are age 24 or older constitute over 30% of the employment group, but approximately 20% of those headed for graduate schools.

Minorities are included in **Table II** to show what proportions they comprise among the physics bachelors; their characteristics are presented in greater detail in **Tables IV** and **V**.

Although many credits in mathematics are required for a physics bachelor's degree, only 30% of the graduates reported a double major. The "other graduate study" group includes 40% with double majors, but their second major is often the discipline associated with their intended subject of graduate study. Almost 90% of the engineering-physics majors enter graduate engineering programs.

And how do postbaccalaureate plans correlate with the type of bachelor's institution chosen by physics majors? **Table II** points to a distinct preference for doctorate granting institutions by physics majors intent on becoming physicists, while the 4-year colleges appear to be preferred by almost half of each of the other groups.

**Fig. II. Physics bachelors entering graduate physics departments who did not take high school physics, 1970-1981**




The acute shortage of high school physics teachers has received more attention recently, and **Figure II** reflects some of the consequences of this shortage. By singling out those physics

**Table III. A comparison between men and women physics bachelors taking high school physics**

| Type of high school physics | | Women N | Women % | Men N | Men % |
|---|---|---|---|---|---|
| PSSC[1] | | 52 | 18 | 466 | 26 |
| PP[2] | | 31 | 11 | 296 | 17 |
| Other | | 142 | 49 | 749 | 42 |
| None | | 64 | 22 | 275 | 15 |
| Total | N[3] | 289 | | 1786 | |
| | % | | 100 | | 100 |

*1 PSSC = Physical Science Study Committee*
*2 PP = Project physics*
*3 Nonrespondents to question = 529*

bachelors each year whose postbaccalaureate plan is physics graduate study, we find that back in 1970 only 4% of that group of physics graduates had never taken physics before entering college; by 1981 that percentage almost quadrupled, while the absolute number of physics bachelors to which these percentages correspond, more than doubled. Focusing on all physics bachelors of the class of 1981 we find that a higher proportion of women than men do not take physics in high school, and that the men are more apt than the women to have taken PSSC. These and other data on types of high school physics are presented in **Table III.**

As the number of minority students rises, it becomes increasingly important to distinguish between U. S. and foreign minorities, especially where employment plans are concerned. Foreign physics bachelors are more likely to enter graduate programs. Adding all U. S. minorities together, **Table IV** shows that their postbaccalaureate plans hardly differ from those of all physics bachelors in 1981; however, a further division of U. S. minorities into U. S. blacks and all other U. S. minorities shows that a significantly smaller proportion of blacks plan to enter graduate schools. They include the largest proportion with immediate employment plans of any group in that table. Other U. S. minority groups, consisting largely of Orientals and Hispanics appear to show greater interest in physics graduate study than all physics bachelors grouped together. Foreign-born Orientals were singled out as the largest foreign minority among physics bachelors because a much larger proportion of them (22% compared with 7%) appear to have their student visas changed to accept employment.

**Table IV. Postbaccalaureate plans of U.S. and foreign minorities among the physics bachelors of the class of 1981.**

| Minorities | Postbaccalaureate plans: Graduate study: Physics | Other | Empl. | Total % | Total N |
|---|---|---|---|---|---|
| U.S. blacks | 26% | 17% | 57% | 100 | 42 |
| Other U.S. minorities | 35 | 23 | 42 | 100 | 94 |
| Total U.S. minorities | 32 | 21 | 47 | 100 | 136 |
| Foreign Orientals | 45 | 33 | 22 | 100 | 42 |
| Other foreign minorities | 39 | 54 | 7 | 100 | 54 |
| Total Foreign minorities | 42 | 45 | 13 | 100 | 96 |
| All respondents | 30 | 24 | 46 | 100 | 2604 |

**Table V** lists seven distinct minority groups and shows the number of respondents in each. The fact that some of the groups are very small accounts for the combining of several minority groups in **Tables II** and **IV**. Noteworthy among the characteristics presented in **Table V** is the large proportion of women among blacks, and that group's concentration in four-year colleges in the Southeastern United States. Citizenship as a characteristic is not generally listed in **Table V**, because the only group which is not predominantly U. S. or foreign is the group of Orientals, and they are divided by citizenship. By dividing the U. S. into four major geographic regions, **Table V** shows how relatively uniform the distribution of minorities is, blacks being the exception.

**Table V. Selected characteristics of minority physics bachelors, 1981**

| Minority group | Sex: Female | Sex: Male | Region* of bach's institution: North-east | South-east | Central & Mountain | Pacific | Type of bach's inst.: BS- | MS- granting | PhD- | Total no. of respondents |
|---|---|---|---|---|---|---|---|---|---|---|
| Black | 10 | 41 | 8 | 29 | 12 | 2 | 38 | 4 | 9 | 51 |
| Mex. Am. | 1 | 10 | 3 | - | 5 | 3 | 5 | 1 | 5 | 11 |
| Am. Ind. | 2 | 6 | 1 | 1 | 6 | - | 2 | 1 | 5 | 8 |
| Hispanic | 5 | 23 | 6 | 4 | 10 | 8 | 7 | 3 | 18 | 28 |
| Asian Ind. | 0 | 13 | 6 | 2 | 3 | 2 | 3 | 1 | 9 | 13 |
| U.S. Oriental | 8 | 35 | 13 | 4 | 12 | 14 | 14 | - | 29 | 43 |
| Foreign Oriental | 7 | 35 | 8 | 6 | 20 | 8 | 15 | 7 | 20 | 42 |
| Arab | 3 | 29 | 7 | 9 | 11 | 5 | 16 | 3 | 13 | 32 |

**Regions: Northeast = New England, Middle Atlantic; Southeast = South Atlantic, East South Central; Central = East North Central, West North Central, West South Central.*

**Table VI. Sources of anticipated support for first-year graduate study*, 1979 to 1981.**

| Sources of support | Students planning: Physics graduate study | | | Other graduate study | | |
|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1979 | 1980 | 1981 |
| Teaching assistantship | 66% | 71% | 67% | 24% | 26% | 28% |
| Research assistantship | 15 | 12 | 14 | 24 | 24 | 18 |
| Fellowship | 12 | 10 | 10 | 15 | 12 | 13 |
| Employment | 2 | 3 | 4 | 11 | 12 | 15 |
| Family, savings, loan | 3 | 2 | 4 | 20 | 23 | 21 |
| Other | 2 | 2 | 1 | 6 | 3 | 5 |
| Graduate study status: full-time | 98% | 98% | 97% | 96% | 96% | 94% |
| Graduate study status: part-time | 2 | 2 | 3 | 4 | 4 | 6 |
| Total: % | 100% | 100% | 100% | 100% | 100% | 100% |
| Total: N | 1372 | 1332 | 1327 | 1083 | 1066 | 1079 |

**The information was reported as of September for each academic year*

Differences in sources of support for first-year graduate students are primarily related to the subject of graduate study and the data in **Table VI** clearly illustrate that observation. Assistantships, both teaching and research, support over 80% of the graduate physics students, but less than half of those entering "other" graduate study. The three most recent years of data are presented in this table to show that despite fluctuations for each source of support, the influence assistantships exert on both groups, remains largely unchanged. The only trend shared by both groups in recent years is the steady increase in students who support their graduate studies through off-campus employment.

Assessing the demand for new physics bachelors is a complex task, but asking the employment-oriented graduates for the number of job offers each received, serves as a good approximation to that assessment. **Table VII** shows a major improvement in the employment outlook since the early 1970's, but simultaneously reflects a recent tightening trend. This inference is drawn from the fact that fewer graduates reported multiple job offers received since 1979.

**Figure III** illustrates the postbaccalaureate plans of the class of 1981 and offers greater detail on two of the four major groups. For example, this figure lists all subjects of "other graduate study" chosen by at least 15 physics bachelors, and it subdivides the employment-oriented graduates into two groups, one of which includes the category "not yet seeking employment". By and large, this group consists of graduates who returned their questionnaires before exploring the job market for suitable employment.

Trend **Table VIII** shows that industry continues to be the largest employer of physics bachelors, as the proportion of new graduates who respond to the demand for high school physics teachers declines. The only significant change among em-

**Table VII. Changes in employment outlook for new physics bachelors, 1973 to 1981.**

| Number of job offers at graduation | Summer 1973 | Summer 1975* | Summer 1977 | Summer 1979 | Summer 1980 | Summer 1981 |
|---|---|---|---|---|---|---|
| 0 | 26% | 17% | 11% | 9% | 10% | 10% |
| 1** | 50 | 56 | 52 | 46 | 50 | 55 |
| 2 or more | 24 | 27 | 37 | 45 | 40 | 35 |

**These figures have been revised from those presented in earlier reports to include military commitments.*

***Bachelors who enter the military service are included here.*

Fig. III. Postbaccalaureate plans of physics bachelors of the class of 1981.

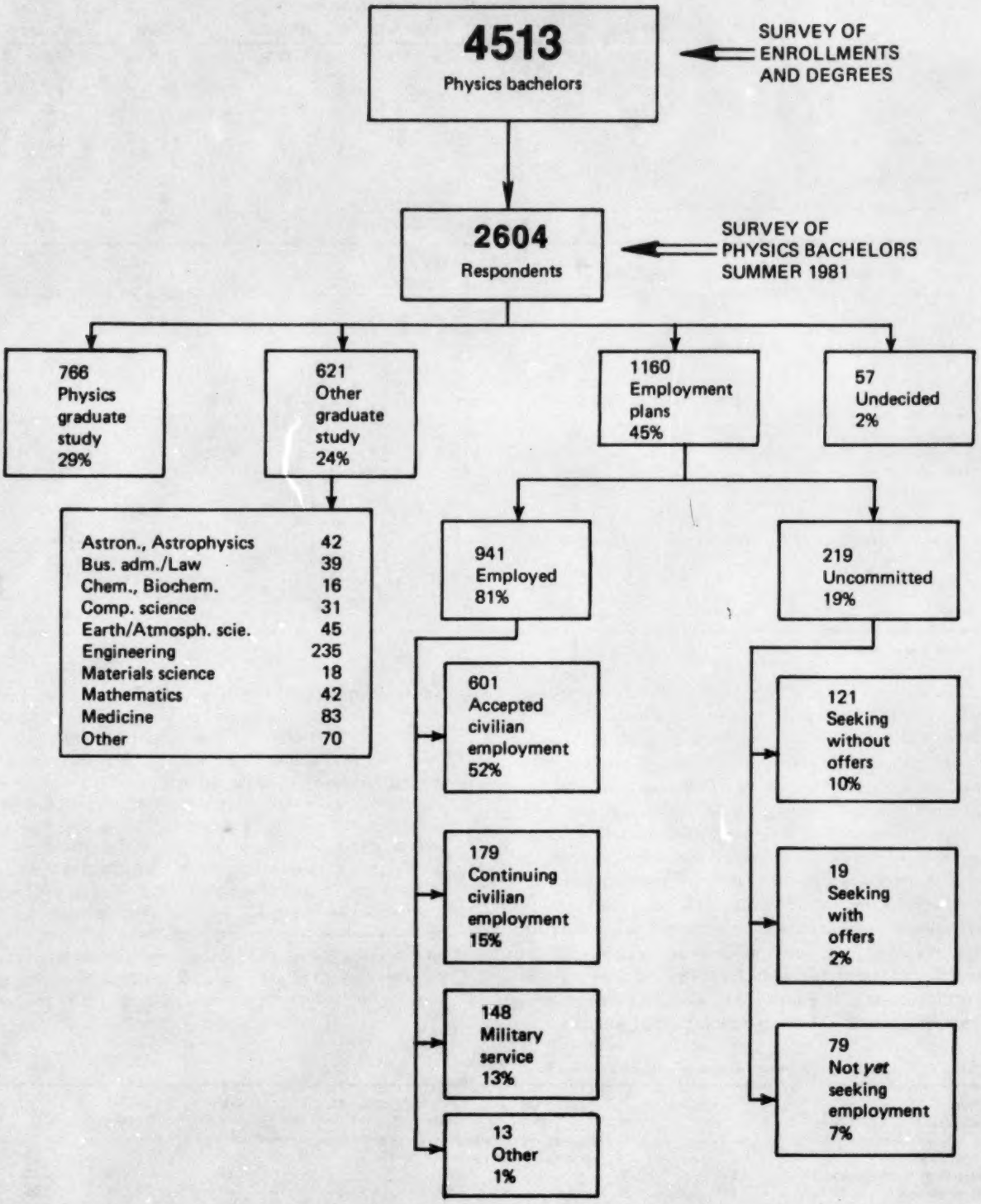


**Table VIII. Initial employment of physics bachelors, 1974-81.**

| Type of employer | Percentage of employed bachelors | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1974-75 | 1975-76 | 1976-77 | 1977-78 | 1978-79 | 1979-80 | 1980-81 |
| Industry manufacture | 25% | 30% | 32% | 37% | 40% | 41% | 40% |
| Industry service | 25 | 19 | 16 | 21 | 18 | 20 | 22 |
| High school | 11 | 11 | 8 | 7 | 6 | 3 | 2 |
| College or univ. | 5 | 4 | 5 | 3 | 4 | 3 | 4 |
| civilian employ. | 9 | 10 | 7 | 7 | 7 | 8 | 7 |
| Government career military | 16 | 13 | 12 | 14 | 15 | 16 | 21 |
| Other | 9 | 13 | 20 | 11 | 10 | 9 | 4 |
| Total | 100% | 100% | 100% | 100% | 100 % | 100% | 100% |

**Table IX. Starting salaries of physics bachelors, 1981.**

| Type of employer | Men (563 reported salaries) | | Women (110 reported salaries) | | Total (673 reported salaries) | |
|---|---|---|---|---|---|---|
| | Dist. by employer | Median monthly salary | Dist. by employer | Median monthly salary | Dist. by employer | Median monthly salary |
| Industry-manuf. | 38% | $1840 | 48% | $1795 | 40% | $1830 |
| Industry-service | 23 | 1810 | 17 | 1700 | 22 | 1805 |
| High school | 2 | 1050 | 3 | * | 2 | 1050 |
| Coll/Univ. | 4 | 1180 | 2 | * | 4 | 1180 |
| Government Civilian | 6 | 1350 | 12 | 1580 | 7 | 1450 |
| Government Military | 23 | 1215 | 8 | 1180 | 21 | 1210 |
| FFRC | 2 | 1885 | 6 | 1450 | 2 | 1700 |
| Other | 2 | * | 4 | * | 2 | * |
| Total | 100% | $1660 | 100% | $1660 | 100% | $1660 |

**Insufficient data*

ployers in the most recent year appears to be the increase from 16% to 21% in graduates choosing a military career. **Table VIII** includes only respondents who accepted new positions, rather than those who continued in positions they held while completing their college degrees, and **Table IX** is based on that same group so as to reflect actual starting salaries. Between 1980 and 1981 the median starting salary for physics bachelors increased only 6.4% because the distribution of employers shifted toward an increase in career military, which offers salaries almost 30% below the median. By excluding the graduates who enter the military, the median monthly salary based on all civilian employers is $1770.—Other recent changes reflected in **Table IX** include an increase in the proportion of women hired by manufacturing industries, and lower overall salaries for women paid by industry.

For the purposes of **Table X**, the employers and work activities of *all* new physics bachelors are shown, and therefore include the 179 graduates who continued the civilian employment they held as undergraduates. A major distinction between those two groups lies in their perceptions of the extent to which they use their physics training. Almost half of the bachelors employed in "newly accepted" positions report extensive use of their physics training; on the other hand, only one-third of those who "continue" their employment describe it in terms of "extensive use of training." Thus examining the work activities in **Table X**, we find small increases in the proportion of graduates working in computer programming, nonphysics occupations, and management training programs. On the other hand, research, development, and engineering work appear to offer fewer opportunities to physics bachelors.

**Table X. Full-time employment* of new physics bachelors, 1981.**

| Work activity | Industry manufacture | Industry service | High school | Government civilian | Government military | Coll/ Univ. | Other | Total N | Total % |
|---|---|---|---|---|---|---|---|---|---|
| Teaching | - | 1 | 19 | 2 | 10 | 4 | 1 | 37 | 4 |
| Research & development | 122 | 46 | - | 41 | 26 | 18 | 8 | 261 | 28 |
| Engineering | 172 | 71 | - | 24 | 35 | 4 | - | 306 | 33 |
| Computer programming | 46 | 45 | - | 17 | 2 | 10 | 10 | 130 | 14 |
| Nonphysics professional | 9 | 26 | 1 | 5 | 38 | 1 | 4 | 84 | 9 |
| Management training | 6 | 9 | - | 2 | 18 | - | - | 35 | 4 |
| Skilled | 24 | 9 | - | 3 | 2 | 1 | - | 39 | 4 |
| Other | 15 | 1 | - | 1 | 17 | 2 | - | 36 | 4 |
| Total N | 394 | 208 | 20 | 95 | 148 | 40 | 23 | 928 | |
| Total % | 42% | 22% | 2% | 10% | 18% | 4% | 2% | | 100% |

**The employment of these 928 graduates includes both newly accepted positions as well as those in which graduates are continuing.*

# ASTRONOMY

**Table XI. Postbaccalaureate plans of successive graduating classes of astronomy bachelors, 1974–1981**

| Postbaccalaureate plans | 1974–75 | 1975–76 | 1976–77 | 1977–78 | 1978–79 | 1979–80 | 1980–81 |
|---|---|---|---|---|---|---|---|
| Astronomy graduate study | 42% | 46% | 28% | 33% | 28% | 35% | 24% |
| Other graduate study | 29 | 29 | 27 | 22 | 19 | 17 | 13 |
| Employment | 23 | 20 | 33 | 40 | 51 | 43 | 59 |
| Undecided | 6 | 5 | 12 | 5 | 2 | 5 | 4 |
| Total number of astronomy bachelors | 163 | 172 | 184 | 177 | 165 | 165 | 156 |

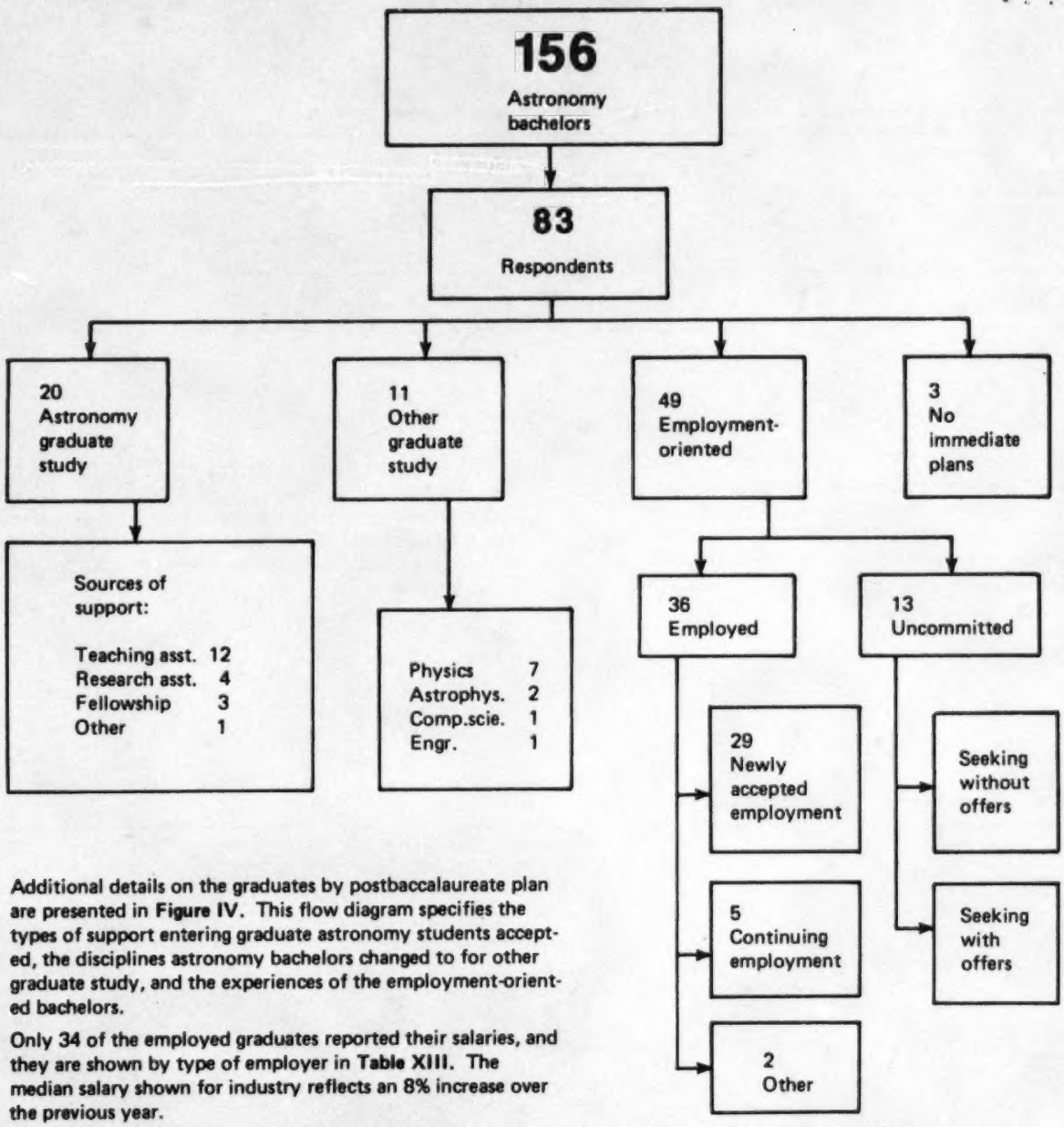
A total of 156 astronomy bachelor's degrees were granted in 1980–81 and **Table XI** compares the postbaccalaureate plans of that class with those of six previous classes. Although the numbers involved are small, a trend away from graduate school and into employment appears evident. Both "astronomy graduate study" and "other graduate study" reached their lowest percentages since the survey was first conducted in the early 1970's.

**Table XII** lists seven characteristics of the 83 respondents. The only significant change from prior years is an increase the number of astronomy bachelors who report a double major with physics.

**Table XII. Characteristics of astronomy bachelors, 1981.**

| Characteristics | | Postbaccalaureate plans | | | | Total |
|---|---|---|---|---|---|---|
| | | Graduate study | | Employment | Undecided | |
| | | Astronomy | Other | | | |
| Sex | Female | 4 | 2 | 9 | 1 | 16 |
| | Male | 16 | 9 | 40 | 2 | 67 |
| Citizenship | U.S. | 19 | 10 | 47 | 3 | 79 |
| | Foreign | 1 | 1 | 2 | - | 4 |
| Race | Am. Ind. | - | - | 1 | - | 1 |
| | Oriental | - | - | 2 | - | 2 |
| | Hispanic | - | 1 | 1 | - | 2 |
| | Arab | 1 | - | - | - | 1 |
| Age | 21 or younger | 2 | 1 | 3 | 1 | 7 |
| | 22 yrs. | 11 | 5 | 25 | - | 41 |
| | 23 yrs. | 4 | 2 | 11 | 2 | 19 |
| | 24 yrs. or older | 3 | 3 | 10 | - | 16 |
| Type of bachelor's institution | PhD-granting | 17 | 9 | 29 | 2 | 57 |
| | MS-granting | - | - | 4 | - | 4 |
| | BS/BA-granting | 3 | 2 | 16 | 1 | 22 |
| Type of degree | Science | 12 | 5 | 33 | 2 | 52 |
| | Arts | 8 | 6 | 16 | 1 | 31 |
| Double major | with physics | 8 | 8 | 15 | 2 | 31 |
| | with mathematics | 3 | - | 2 | - | 5 |
| | with other | - | 1 | 2 | - | 3 |
| Total respondents | | 20 | 11 | 49 | 3 | 83 |

**Fig. IV. Postbaccalaureate plans of astronomy bachelors of the class of 1981**




Additional details on the graduates by postbaccalaureate plan are presented in **Figure IV**. This flow diagram specifies the types of support entering graduate astronomy students accepted, the disciplines astronomy bachelors changed to for other graduate study, and the experiences of the employment-oriented bachelors.

Only 34 of the employed graduates reported their salaries, and they are shown by type of employer in **Table XIII**. The median salary shown for industry reflects an 8% increase over the previous year.

**Table XIII. Starting salaries for astronomy bachelors, 1981.**

| | Type of employer | | | | |
|---|---|---|---|---|---|
| | Industry | Government | High school | Other | All employers |
| Median monthly salary | $1700 | $1400 | $950 | $1000 | $1485 |
| Number reporting | 16 | 8 | 3 | 7 | 34 |